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ABSTRACT

This study used a sample of 3- and 4-year-old children of female respondents from the 1986 National Longitudinal Surveys Youth Cohort to analyze the relationship between maternal labor supply and children's cognitive development. Respondents were 21 to 29 years old in 1986. Thus, the sample consisted of children of relatively young mothers. Findings indicated that the impact of maternal labor supply depended on when the labor occurred. Maternal employment was found to have a negative impact when it occurred during the first year of the child's life and a potentially offsetting positive effect when it occurred during the second and subsequent years. Although there was some evidence that boys were more sensitive to maternal labor supply than girls, the gender difference was not significant. The negative first-year effect was not mitigated to any great extent by the increased maternal income that accompanied it. However, the increase in maternal income did appear to play an important role in producing a positive effect in the second and later years. A total of 18 references, and 60 working papers of the National Bureau of Economic Research, are cited. (Author/RH)

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NATIONAL BUREAU OF ECONOMIC RESEARCH, INC.

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ABSTRACT

This paper analyzes the relationship between maternal labor supply and children's cognitive development, using a sample of three- and four-year-old children of female respondents from the 1986 National Longitudinal Surveys Youth Cohort (NLSY). Respondents in the NLSY were aged 21 to 29 in 1986; thus our sample consists of children of relatively young mothers. We show that for this group the impact of maternal labor supply depends upon when it occurs. Maternal employment is found to have a negative impact when it occurs during the first year of the child's life and a potentially offsetting positive effect when it occurs during the second and subsequent years. We find some evidence that boys are more sensitive to maternal labor supply than girls though the gender difference is not significant. The negative first-year effect is not mitigated to any great extent by the increased maternal income that accompanies it, though the increase in maternal income does appears to play an important role in producing the positive effect in the second and later years.

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Maternal Labor Supply and Children's Cognitive Development

I. Introduction

Over the past 30 years there has been a dramatic increase in the labor force participation rates of mothers of young children. Between 1960 and 1988, the participation rate of married women with children under six increased from 19 to 57 percent, and by 1988 52 percent of all women with infants one year of age or less were in the labor force. This paper examines the consequences of this growing commitment of mothers to market work for the cognitive development of their children. We find that proper assessment of this impact must take into account the timing of the mother's labor supply relative to the birth of her child.

We analyze data on three- and four-year-old children born to female respondents in the 1986 National Longitudinal Survey of Youth (NLSY).[1] We focus on pre-school age children since the largest inputs of a mother's time would traditionally be directed at these children. Restricting the sample to the preschool group also enables us to obtain results uncontaminated by differences in school quality.[2] Respondents in the NLSY were aged 21 to 29 in 1986, thus our sample consists of children with relatively young mothers.[3]

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[1]For a description of the NLSY data see Center for Human Resource Research (1989).

[2]Our measure of cognitive development is not available for children younger than 3.

[3]For the U.S. population as a whole in 1986, the median age for mothers was 23.6 years at the birth of the first child, 26.7 years at the birth of the second and 28.4 years at the birth of the third. (Vital Statistics of the United States, 1987). For mothers in our sample, the median age was 20.8 years at the time of birth for first children, 22.2 years for second children and 23.1 years for third children. All statistics presented in this paper have been weighted by sample weights provided in the NLSY to correct for the oversampling of minorities and low income whites.

It is likely that this limitation of the age range affects other familial characteristics such as mother's education and family income so that our sample, while representative of children of women in this age group, is unlikely to be representative of all three- and four-year-old children. In our sample, almost 81 percent of the children had mothers who worked at some time during their lives; 51 percent had mothers who worked during their first year of life and 78 percent had mothers who worked during the second and subsequent years. Thus, the issue of maternal employment is of considerable importance for this group.

While economists have made some efforts to examine the relationship between maternal labor supply and children's intellectual development and achievement, no consensus has emerged from the existing literature.[4] On the one hand, Leibowitz (1977), found no statistically significant effects of maternal employment on standardized scores of the Peabody Picture Vocabulary Test (PPVT) for a sample of three- to five-year-olds, and Datcher-Loury (1988) found that maternal labor supply had no effect on educational attainment for a sample of grown children aged 20 to 26, but that maternal time spent at child care increased the individual's schooling if the mother was more highly educated. On the other hand, Fleisher (1977) found a positive effect of mother's home time on high school IQ for a male sample, and Krein and Beller (1988) found a negative effect of maternal labor supply on the educational attainment at age 26 of boys, but not girls. Similarly, Stafford (1987),

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[4]Much of the relevant prior research has come from other social sciences, where there has also been a lack of consensus. The outcome of this research is probably best summarized by Bronfenbrenner and Crouter (1982), who conclude from their extensive review that, "Taken by itself, the fact that a mother works outside the home has no universally predictable effects on the child" (p. 51).

using parental time diaries, found that maternal labor supply in 1975 (during the preschool years) had a negative effect on teachers' ratings of grade-schoolers' cognitive abilities in 1982. Most recently, Desai, Chase-Lansdale and Michael (1989), using the 1986 NLSY, found that the standardized PPVT scores of four-year-old boys in high income families were negatively affected by maternal labor supply, while those of four-year-old girls were unaffected.[5]

Our study has a variety of advantages over these previous efforts at understanding the relationship between maternal labor supply and children's cognitive development. First, we address a selectivity issue that has not been considered in prior work. Employed mothers are a self-selected group of labor force participants. Economic theory suggests that the participation decision is made on the basis of a comparison between home and market productivity. Thus, it is possible that employed and nonemployed mothers differ in unmeasured characteristics related to their production of child quality, and that this results in biased OLS estimates of the impact of maternal employment. As explained below, we use an instrumental variable approach to address this issue.

Second, we are able to construct precise and continuous measures of maternal labor supply for the first year of the child's life as well as for subsequent years. Some recent research by psychologists suggests that maternal employment during the first year of life may have particularly adverse consequences (Belsky and Rovine, 1988), though this finding has been controversial (Gottfried and Gottfried, 1988). By separating the effect of

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[5]The finding that mother's working outside the home has a negative effect on boys but not on girls has also appeared in studies done by non-economists, though there is some disagreement in this area (Gottfried and Gottfried, 1988).

maternal labor supply in the first year from that in subsequent years, we are able to observe any differential impact that maternal labor supply has on the child's cognitive ability over the course of his/her early life. By comparison, previous studies have tended simply to use dummy variables indicating whether or not the mother worked or have not distinguished when in the child's life maternal employment occurred.[6] Studies based on adult respondents tend to have even more imprecise measures of when maternal employment occurred.

Our use of the NLSY data also permits us to construct exceptionally detailed control variables which better enable us to identify the *ceteris paribus* effects of maternal employment. These include a measure of mother's cognitive ability, duration of the child's residence in a female-headed family and measures of the financial resources available to the family over the child's life. Finally, an advantage of our focus on children's cognitive ability during the preschool years is that parental inputs are likely to be particularly important, whereas educational attainment and IQ at adulthood may be influenced by a variety of other factors for which it is difficult to control. In addition, since few mothers of preschool children worked in the 1960s, studies conducted on children who were older or grown in the 1970s and 1980s tend to reflect the impact of maternal employment during the child's school years and are of limited usefulness in assessing the consequences of recent trends.

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[6]Desai, et. al. (1989) do, however, distinguish between continuous or intermittent employment, while Leibowitz (1977) differentiates between full- and part-time work. Stafford's (1987) measure of labor supply, weekly minutes of market work in 1975 is measured at a variety of ages in the children's preschool years.

II. Conceptual Framework and Estimation Strategy

The economic model of the family developed by Becker (1981) and others forms the conceptual basis for our analysis of the consequences of maternal labor supply. The family's objective is assumed to be maximization of the utility that it derives from consuming the various goods that it produces using inputs of family members' time and market-purchased goods and services. In this framework, child services is viewed as one particular consumption good from which parents derive utility. The family's level of consumption of child services depends on both the number of children that it produces, and on the quality of each child. Our focus in this paper is on understanding the factors that affect the production of child quality as indexed by children's standardized test scores on the Peabody Picture Vocabulary Test (PPVT).

Our basic estimating equation is specified for the ith child as follows:

$$PPVT = \beta_0 + \beta_1 \text{Quantity of Maternal Time} + \beta_2 \text{Quality of Maternal Time} + \beta_3 \text{Quality of Paternal Time} + \beta_4 \text{Market Goods} + \beta_5 P + \epsilon \quad (1)$$

where P is a vector of personal characteristics, and the error term ϵ is assumed to obey the classical assumptions.

Our dependent variable, the PPVT, was administered to all children of female respondents in 1986. The PPVT is a widely recognized measure of cognitive ability, particularly verbal intelligence, and is highly correlated with scores on other intelligence tests (Center for Human Resource Research, 1989). It is standardized for age. Our sample consists of 874 children aged 36 to 59 months at the time the test was administered. We eliminated children

with serious disabilities, those for whom administration of the PPVT was terminated prematurely, those for whom no standardized scores were reported, and those with missing values for the variables used in the analysis.[7] An exception to this is that when explanatory variables had large numbers of missing values we retained observations by creating dummy variables for missing. We further restricted the sample to three- (four-) year-old children whose mothers had been interviewed in each of the three (four) prior surveys. Table 1 gives descriptions and summary statistics for the dependent variable PPVT and for each of the vectors of independent variables shown in equation (1). Sample statistics and regression analyses are weighted by the mother's sample weight provided in the NLSY to correct for the oversampling of blacks, Hispanics and low-income whites, and to produce results representative of the children of women in this age group (21 to 29) nationally. It is important to note, though, that due to this age limitation, even the weighted sample is not nationally representative of all three- and four-year-olds.

The child's cognitive development at a point in time is assumed to be the cumulative result of all inputs throughout the child's life. The explanatory variables have been defined accordingly. Thus, the quantity of maternal time available to the child is measured inversely as the proportion of weeks worked during the first year after the child's birth and the

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[7]We omitted children whose mothers reported that they suffered from brain dysfunction, hearing problems, sight problems, mental retardation, and emotional disturbances, since for these children maternal labor supply is more likely to be a result of child quality than a determinant of it. Also, since standardized PPVT scores of less than forty are not available, children scoring below the minimum were given values of zero on the NLSY tape. These children were dropped from our analysis.

proportion of weeks worked during subsequent years.[8] These measures allow us to ascertain whether the impact of maternal employment differs depending on when it occurs in the child's life, and also allow us to account for the fact that since children's ages vary continuously in our data set, actual numbers of weeks worked by mothers during their children's lives are not strictly comparable across children.[9] Ideally, of course, we would prefer direct information on maternal time spent in child care, but such time use information is not available in the NLSY. However, in this age range of children, there is likely to be a fairly strong negative correlation between total time spent with the child (in custodial and developmental activities) and time spent in market work, so that labor supply may be a good proxy for time spent in child care. On the other hand, employed mothers, may be able to compensate to some extent for their lesser total time inputs by allocating a

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[8]The NLSY allows us to measure these time periods from the date of birth, rather than merely in calendar years. Information on maternal labor supply is derived from the employment histories of the mothers. It should be noted that women who are on vacation, on sick leave, on unpaid leave of less than one month, or on maternity leave of less than 90 days are considered employed. This qualification would mainly apply to no more than the first two to three months after birth, so that we would not expect it to have a major impact on our results. However, to the extent that it does affect our measurement of maternal employment, it would tend to bias the coefficient on the first year labor supply variable toward zero, thus strengthening our confidence in the finding of a significant effect.

[9]Consider two children whose mothers have both worked 100 percent of the weeks during the children's lives, but whose ages differ by six months. Our measure of maternal labor supply assigns the same values to these children, even though the actual numbers of weeks worked by the mothers after the births of their children differ.

greater portion of their time to developmental activities.[10]

The quality of mother's time is gauged by her verbal ability in 1979 as measured by the Armed Services Vocational Aptitude Battery. We also use years of education at the first interview after the child's birth as an indicator of the quality of maternal inputs. Unfortunately we have no explicit information on the quantity of paternal time, although to some extent time spent in a female-headed family is an inverse measure of paternal time inputs. We are, however, able to include father's education in the interview immediately following or preceding the child's birth as a measure of the quality of his time. Since fathers were not explicitly identified in the NLSY, the respondent's marital history was employed in conjunction with the child's date of birth and the interview date to identify the father. Thus, this variable was given a missing value if the child was born out of wedlock. In addition to reflecting the quality of parental time inputs, the indicators of parental ability and education may in part be proxies for the initial endowments of the children.

The NLSY does not allow us to observe quantities of specific market goods and services used in children's upbringing. As proxy measures of the family's ability to pay for market goods and services, however, we do include spouse's average income during the child's life and average family income net of mother's and spouse's incomes during the child's life. Mother's average income was omitted from our basic specification so that we could observe the

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[10]Tabulations from the 1975/76 Study of Time Use based on time diaries indicate that among wives whose youngest child was 0-5 years, employed wives spent 50.3 percent (76 minutes) less time per day in basic childcare activities than nonemployed wives, and 29.2 percent (19 minutes) less time per day in other childcare activities (including developmental activities) (Pleck, 1983, p. 259).

full effect of maternal labor supply on children's cognitive development without controlling for any accompanying increases in income. Mother's income is included in one of our later specifications.

In assessing the impact of maternal labor supply on children's cognitive development, we have endeavored to control for important personal and environmental characteristics of children's lives. As with the maternal labor supply variables described above, our continuous measures of the children's environments are stated as proportions of the child's life to adjust for variation in the children's ages. One particularly important dimension of the child's environment is whether or not the father or a father figure is present in the household. Much concern has been focused recently on the growing proportion of American children who spend at least parts of their lives in families headed by single mothers. As Garfinkel & McLanahan (1986) state, "... compared with children who grow up in two-parent (husband-wife) families, the children from mother-only families are less successful on average when they become adults." (p. 1)[11]

In the context of the standard neoclassical model of the family, there are at least two potential sources for this widely observed negative effect of female-headedness on children. The first is the likely decline in the quantity of parental time used in the production of children's cognitive abilities, as the mother is much more likely to be a labor force participant, and the father is likely to contribute little or no time. Second is the concurrent decline in household income. The NLSY data give us the ability to ask whether female-headedness affects children's cognitive development when

[11]See also Krein and Beller (1988).

maternal time and family income are held constant. Using information on the respondent's marital history in conjunction with the child's date of birth we have constructed a variable measuring the proportion of months in the child's life during which his/her mother was not married. The incidence of time spent in female-headed families in the sample is substantial, with 28.9 percent of the children spending at least one quarter of their lives and 15.5 percent spending their entire three- to four-years in such families.

We also control for number of children in the household since it is expected that, all else equal, the larger the number of children in the family, the smaller the amount of time and resources that may potentially be devoted to each child and hence the lower the test score. Since it is expected that any health conditions that limit a mother's ability to perform market work will also limit her ability to care for and to contribute to the development of her child, mother's health status is included as an explanatory variable.[12] Similarly we control for the existence of child health problems which might be expected to slow cognitive development.[13] We also include controls for race and ethnicity, gender and region of residence.[14]

As noted above, one potential problem with OLS estimation of equation

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[12]This variable measures the proportion of years in the child's life during which his/her mother reported that her health would limit the kind or amount of she could do, or would prevent her from working for pay. The mother's health status as reported at the time of each survey was assumed to have prevailed throughout the preceding year.

[13]The health problem variable was given a value of one if the child's mother reported that the child had a health problem that limited his/her school attendance, school work, play or sports activities, or that required attention from a doctor, or use of medicine, drugs or special equipment.

[14]The region variables measure the proportion of years in the child's life during which he/she lived in the given regions and assume that the region reported at the time of each survey prevailed throughout the preceding year.

(1) is that labor force participation is a choice variable. Economic theory suggests that the participation decision is determined by a comparison of home and market productivity. If, as a result, unmeasured characteristics of the mothers associated with their production of child quality are correlated with our measures of the quantity of maternal time inputs, then the estimated coefficients on the maternal labor supply variables will be biased, as they will be correlated with the error term. It is not possible to specify a *priori* the direction of this bias. On the one hand, if women who remain at home are a self-selected group with exceptionally high home (including child quality) productivity, the coefficient on maternal employment will be biased downward. That is, some of the estimated adverse effects of maternal employment may in part be due to the higher home productivity of nonemployed mothers. If, on the other hand, labor force participants are a self-selected group of exceptionally able women with high wage offers, the bias could be reversed.[15]

To correct for this potential heterogeneity bias we estimate our basic equation using instrumental variables for the maternal labor supply variables. The instruments were estimated using fitted values from two-limit tobit

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[15]Another possible source of selection bias is from heterogeneity in unmeasured characteristics of children. The mothers of children experiencing health or developmental problems may be more likely to remain at home. To the extent that these problems also lower the child's PPVT score, the coefficient on maternal labor supply would be biased upward. However, this potential bias is not likely to be serious because we have excluded children with serious disabilities from the sample and also controlled for child's health status in our regressions. In any case, our instrumental variable approach would correct for this source of bias as well.

analyses of the labor supply variables.[16] The explanatory variables used in this analysis and the results of the tobit regressions are shown in the Appendix. If we let X be the matrix of explanatory variables in our basic specification (1) above, Z be the matrix of explanatory variables except that the maternal labor supply variables have been replaced by their fitted values from the tobit analyses, and , be the standardized score on the PPVT, then the coefficient vector b_{iv} is

$$b_{iv} = (Z'X)^{-1}Z'y. \tag{2}$$

Heckman (1976) has shown that this estimator is consistent, asymptotically normal, and that its asymptotic variance-covariance matrix can be calculated from the usual instrumental variable estimation formula.

Because the IV estimator is relatively cumbersome as well as inefficient, it is useful to test for the existence of heterogeneity bias. If the sample is homogeneous so that the OLS estimator (b_{ols}) is consistent, we would expect to find that $\text{plim}(b_{iv})=\text{plim}(b_{ols})$. We use a procedure suggested by Hausman (1978) to test this hypothesis against the alternative that $\text{plim}(b_{iv}) \neq \text{plim}(b_{ols})$.

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[16]Almost half of the children in the sample had mothers who worked zero weeks during the child's first year, and almost one quarter had mothers who worked zero weeks during the second and subsequent years. About seven percent of all children had mothers who worked 100 percent of their first year of life, and about five percent had mothers who worked 100 percent of the second and subsequent years of their lives.

III. Empirical Results

Table 2 presents OLS and IV estimates of our basic equation in columns (1) and (2), respectively.[17] The two sets of estimates are quite similar, except for the estimated effects of maternal labor supply. In the OLS equation, maternal labor supply is estimated to have a significant negative effect during the first year of the child's life, and a significant positive effect during the second and later years. In the IV equation these variables have the same signs and their coefficients are actually considerably larger in absolute value than the OLS coefficients. However they are very imprecisely estimated and are not statistically significant. We fail to reject the null hypothesis of equality between the OLS and IV coefficients using the Hausman procedure.[18] Since we are unable to find statistical evidence of heterogeneity, we assume from this point on that our sample is homogeneous.

The main finding from our basic specification is that the impact of maternal labor supply on children's cognitive development is sensitive to the period during which the mother works. A woman who works 100 percent of the weeks during her child's first year of life is expected to lower the child's standardized score by about 5.8 points, *ceteris paribus*, while a woman who works 100 percent of the weeks in the second and later years is expected to

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[17] Observations with missing values for the instrumental variables were dropped from the IV equation in column (2).

[18] When both equations are estimated using the 843 observations with valid values of the instrumental variables, the test statistic has a value of .31, well below the critical chi-square value of 4.61 at the ten percent level of significance.

raise her child's score by about 4.2 points.[19] The positive effect of maternal employment during the latter period may at first appear surprising, but there are at least two explanations for this finding. First, the positive total effect may reflect primarily the positive indirect effect of the increase in family income associated with maternal employment. Second, nonmaternal care during this period of the child's life, accompanied as it often is by broader contacts with other children and adults, may have a positive effect on cognitive development. Additional analyses below shed light on this issue.

Given the opposing signs of the total effect of maternal labor supply during the first and subsequent years of life, it is interesting to consider the cumulative effect on the cognitive development of three-and four-year olds of maternal employment in both periods. We cannot reject the null hypothesis that the two effects sum to zero, i.e., that the labor supply of a mother who works 100 percent of the time during her child's first three or four years of

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[19]We do not adjust for full- vs. part-time work here. Previous specifications indicated that a control for proportion of weeks worked part-time was not significant and did not affect the other findings. In a separate specification, we examined the impact of maternal labor supply in the first and second halves of the child's first year of life separately to see whether maternal employment has greater adverse effects in the earlier period. The estimated coefficients were -3.3111 for the first half and -2.5005 for the second half, suggesting that the first year effect is fairly equally divided between the first and second half years. (The difference in the size of the coefficients was not significant, as the value of the t-ratio was -.22. The two variables were jointly significant at the 1 percent level. The value of the F-test statistic was 9.73.) Note that since some women who are considered employed may be on maternity leave, the coefficient on the first half year variable may be biased towards zero. Thus it is possible that maternal employment during the first half year has a larger negative impact than our estimate would indicate.

life would have no net effect on her child's cognitive ability.[20] This may indicate why studies that do not take the timing of labor supply into account often find no effect on children's cognitive ability. This finding suggests that maternal employment throughout the first three or four years does not have adverse effects on children, although some gains might be achieved by delaying labor force entry. It is important to note that these findings reflect the impact of the actual child care arrangements made by the women in the sample and do not necessarily imply that all forms of alternative care during the first year of life have negative effects.

With respect to the impact of other variables, the results in column (1) indicate that the quality of parental time is important, as the mother's verbal ability score significantly increases the child's PPVT score. Father's education also has a significant positive effect. Mother's education has the expected positive sign but is not significant. This probably reflects collinearity with mother's test score and father's education. Number of children in the household has a significant negative effect as expected. It is interesting that this effect shows up strongly even by age three or four, and even in our limited sample of children of young mothers who have in many instances not yet completed their families.[21] Spouse's average income has a significant positive effect, though net average family income is not found to

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[20] A t-test of the null hypothesis that the two effects sum to zero has a value of -.98.

[21] Birth order was included in some preliminary specifications, but was never significant when number of children was also included. Given that 54 percent of the children in our sample are first born and 30 percent are second born -- a result of the fact that the NLSY mothers are relatively young -- it is likely that the high degree of collinearity between birth order and number of children interferes with the identification of their independent effects.

be significant.[22] The impact of living in a female-headed household has the expected negative sign, but it's effect is not significant. We examine the results for female-headedness in greater detail below.

The maternal and child health variables have the expected negative signs, though their coefficients are not significant.[23] Consistent with previous studies, we find sizable significant negative effects for blacks and Hispanics, which may be a reflection of cultural biases in the PPVT, or other omitted factors.[24] All else equal, for this age group, boys' scores are found to be significantly lower than girls' by about 2.2 points. Most likely this reflects the emphasis of the PPVT on verbal intelligence (Maccoby and Jacklin, 1974). Finally, children who have spent all of their lives in the South score about 3.2 points lower than children who have spent all of their lives in the Northeast, while living in the West and North-Central United States had no significant impact.

The effect of maternal employment and of some of the other variables is examined in greater detail in the alternative specifications shown in Table 4. Our basic specification was designed to capture the total effect of maternal

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[22] Since the income variables may reflect the family's demand for child quality, rather than their inputs of market goods and services, we reestimated equation (1) in an alternative specification omitting all income variables. Our findings were unaffected.

[23] Recall that children with serious disabilities were omitted from our sample, so that we only observe the effects of less serious health problems here. In earlier specifications we controlled for low birth weight as well. However, that variable was insignificant and its inclusion did not affect the other results.

[24] For other examples of this result, see Leibowitz (1977) and Desai, et. al. (1989). This finding was unchanged when we omitted children who were reported by the interviewer to have had difficulty understanding the PPVT due to language problems.

labor supply, which is the sum of the direct effect of maternal employment, controlling for any increment in income due to maternal employment, and the indirect effect due to the income increase. In column (3) we add mother's average income over the period to the basic equation to gain greater insight into these two separate components. In this specification, the negative coefficient for maternal labor supply during the first year of the child's life is slightly larger in absolute value than in the basic specification (-6.79 vs. -5.79), and remains significant, suggesting that during the first year of the child's life the positive indirect effect of higher incomes when mothers work compensates only slightly for the negative direct effect of their absences from the home. On the other hand, the coefficient for maternal labor supply during the second and subsequent years is reduced by one third and is no longer significant. This suggests that the indirect effect of the increase in family income that occurs when the mother works plays an important role in producing the positive total effect of maternal labor supply in the second and later years.

It might be argued that a similar issue exists with respect to number of children. Mothers who participate in the labor force may reduce their time commitments to non-market production by having fewer children than women who are not labor force participants. Hence, the impact of maternal labor supply may occur both directly, through the substitution of time in the labor market for time spent in the production of child quality, and indirectly, through a reduction in the number of children that a woman chooses to bear. In this context, to observe the full effect (both direct and indirect) of maternal labor supply on children's cognitive development, we omit number of children as well as maternal income from the regression in column (4). The coefficient

on maternal labor supply during the child's first year of life is unchanged from our basic specification, and remains significant. This is not surprising since most of the children in our sample are first born, and hence their environments during their first year of life would not be affected by their mother's cumulative fertility decisions. The coefficient for maternal labor supply during the child's second and subsequent years of life is significant and increases to 5.40 from 4.16 in the original specification, indicating that the reduced fertility of women with strong labor force attachment provides some benefit to their children, as early as the third or fourth year of life.

Several of the previous studies cited above suggest that any negative effects of maternal labor supply on child development tend to be concentrated among boys. To investigate this issue, we interact the male dummy variable with maternal labor supply in column (5). Our results provide modest support for these earlier findings. While the gender differences are not statistically significant, the coefficients on the interaction terms are larger than their standard errors. According to our estimates, maternal labor supply has a larger negative impact on boys than on girls during the first year of life, and a larger positive impact on boys during the second and subsequent years.

We now turn to a closer examination of the impact of time spent in female-headed families on children's cognitive development. In our basic regression the proportion of the child's life spent in a female-headed household had the expected negative sign but was not significant. It is possible that the inclusion of father's education in the basic regression confounds the effect of female-headedness, since children who live in female-headed households are more likely to have unknown values for father's

education.[25] However, the proportion of time spent in a female-headed family remains insignificant even when father's education is dropped from the regression. Taking this result in conjunction with the results from column (1), we conclude that female-headedness, in and of itself, has no impact on children's cognitive development. However, it is still possible that it affects children's cognitive ability indirectly via the lower incomes of these households. In column (6) we drop all the income variables, as well as the paternal education variables, so that we can observe the full impact of female-headedness. In this specification, the coefficient on proportion of months in a female-headed family is negative and significant at the ten percent level, using a one-tailed test. Our estimates indicate that a child who spends all of his/her life in a female-headed household is expected to score about 2.3 points lower on the PPVT, *ceteris paribus*. This effect appears to be primarily due to the lower income associated with female-headedness.

IV. Conclusions

This paper analyzes the relationship between maternal labor supply and children's cognitive development, using a sample of three- and four-year-old children of female respondents from the 1986 NLSY. Respondents in the NLSY were aged 21 to 29 in 1986; thus our sample consists of children of relatively young mothers. We show that the impact of maternal labor supply depends upon when it occurs. Maternal employment is found to have a negative impact when it occurs during the first year of the child's life and a potentially offsetting positive effect when it occurs during the second and subsequent

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[25] Recall that father's education is only observed for children born within marriages.

years. We find some evidence that boys may be more sensitive to maternal labor supply than girls, though the gender difference is not significant. The negative first-year effect is not mitigated to any great extent by the increased maternal income that accompanies it, though the increase in maternal income does appears to play an important role in producing the positive effect in the second and later years. We also find no evidence that length of residence in a female-headed household has any effect on children's cognitive ability, *ceteris paribus*, although the lower family income that is associated with female-headedness does have a negative effect on children's cognitive development.

One potentially important econometric issue that has received inadequate attention in previous work is that employed mothers are a self-selected group of labor force participants. Since the participation decision is made on the basis of a comparison between home and market productivity, employed and nonemployed mothers may differ in their unmeasured characteristics related to the production of child quality. This may result in biased OLS estimates of the impact of maternal employment although the direction of this bias is unclear *a priori*. We use an instrumental variable approach to address this problem. While we find no statistical evidence of heterogeneity, we believe that this is an important issue and worthy of further investigation with other data sets.

In evaluating these results, it is important to keep three qualifications in mind. First, given the age limitations on the NLSY respondents, our sample is comprised of children with relatively young mothers and thus our results may not be representative of all three- and four-year-old children. Second, our findings reflect the impact of the actual child care

arrangements made by the women in the sample and do not necessarily imply that all forms of alternative care during the first year of life have negative effects or that alternative care in the second and subsequent years necessarily has positive effects. Third, the permanence of the effects we have identified cannot be determined at this point. That is, it is possible that the differences among children associated with maternal employment which we observe during this early period in their lives will change in magnitude or even alter in sign as they age. Bearing these qualifications in mind, our findings suggest that if maternal employment during this early period has deleterious effects, they are most likely centered in the first year of life. Public policies designed to improve the quality of alternative care during this time and/or to encourage greater opportunities for parental leaves during this period might offset these effects.

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Table 1: Descriptions and Summary Statistics of Child Quality Regression Variables (n=874)

	Mean	Std. Dev.
Child Quality		
Standardized score on Peabody Picture Vocabulary Test	91.18	18.06
Quantity of Maternal Time		
Proportion of weeks worked by mother in 1st year of child's life	.27	.35
Proportion of weeks worked by mother in 2nd and later years of child's life	.43	.37
Quality of Maternal Time		
Mother's verbal ability as measured by the Armed Services Vocational Aptitude Battery, administered in 1979[a]	-.29	.98
Mother's verbal ability unknown (dummy=1 if unknown)	.06	.24
Mother's years of education in year of child's birth	11.67	1.73
Quality of Paternal Time		
Father's years of education in year of child's birth[a]	12.22	2.03
Father's education unknown (dummy=1 if unknown)	.28	.45
Market Goods		
Spouse's average income (+ $1000) during the child's life, 1986 dollars[a]	12.39	11.51
Spouse's average income unknown (dummy=1 if unknown)	.08	.27
Mother's average income (+ $1000) during the child's life, 1986 dollars[a]	3.62	4.67
Mother's average income unknown (dummy=1 if unknown)	.02	.01
Average family income (+ $1000) net of mother's and spouse's incomes, 1986 dollars[a]	3.88	5.64
Net family income unknown (dummy=1 if unknown)	.32	.47
Personal Characteristics		
Black (dummy=1 if black)	.18	.39
Hispanic (dummy=1 if hispanic)	.09	.28
Proportion of child's life spent in Southern states	.39	.47
Proportion of child's life spent in Western states	.17	.37
Proportion of child's life spent in North-Central states	.29	.44
Proportion of child's life spent in female-headed household	.24	.39
Proportion of child's life during which mother's health would have limited her work	.08	.19
Number of childrer in household	2.06	.96
Child has health problem (dummy=1 if problem)	.08	.28
Male (dummy=1 if male)	.51	.50

[a]Mean and standard deviation computed for known values.

Table 2: OLS and IV Regression Results for 3- and 4-Year Olds: Dependent Variable is Standardized Score on Peabody Picture Vocabulary Test (t-ratios in parentheses)

	(1) OLS	(2) IV	(3) OLS	(4) OLS	(5) OLS	(6) OLS
Quantity of Maternal Time						
Proportion of weeks worked by mother in 1st year	-5.7846 (-3.1136)	-12.9008 (-.9414)	-6.7904 (-3.4493)	-5.7557 (-3.0762)	-3.2473 (-1.2233)	-5.2594 (-2.8386)
Proportion of weeks worked by mother in 2nd and later years	4.1617 (2.2320)	19.6399 (.7316)	2.7785 (1.2544)	5.3961 (2.9225)	1.4815 (.5569)	3.2706 (1.7830)
Proportion of weeks worked by mother in 1st year x male	-	-	-	-	-4.8577 (-1.3148)	-
Proportion of weeks worked by mother in 2nd and later years x male	-	-	-	-	5.0084 (1.4069)	-
Quality of Maternal Time						
Mother's verbal ability	5.0476 (7.5644)	4.2291 (2.8315)	4.9166 (7.3671)	4.8836 (7.2836)	5.0679 (7.5883)	5.3579 (8.1818)
Mother's verbal ability unknown	-5.3503 (-2.5348)	-4.3840 (-1.7933)	-4.9588 (-2.3467)	-5.6885 (-2.6786)	-5.2164 (-2.4694)	-5.2898 (-2.5101)
Mother's years of education	.1741 (.4744)	-.0048 (-.0075)	.1635 (.4445)	.4778 (1.3274)	.1878 (.5113)	.6097 (1.8216)
Quality of Paternal Time						
Father's years of education	.6986 (1.9122)	.9907 (1.5486)	.7079 (1.9405)	.6484 (1.7635)	.6759 (1.8487)	-
Father's education unknown	7.7186 (1.6642)	10.9939 (1.1508)	[illegible] (.[illegible])	7.8980 (1.6909)	7.3631 (1.5857)	-
Market Goods						
Spouse's average income	.1084 (1.7215)	.1649 (1.1201)	.1007 (1.5956)	.1050 (1.6550)	.1128 (1.7858)	-
Spouse's income unknown	-1.7813 (-.8002)	.0590 (.0159)	-1.4814 (-.6649)	-2.0738 (-.9255)	-1.6995 (-.7615)	-
Mother's average income	-	-	.2318 (1.3447)	-	-	-
Mother's income unknown	-	-	-7.3930 (-1.9258)	-	-	-
Average other family income	.0060 (.0515)	.1153 (.6939)	.0107 (.0928)	.0098 (.0837)	.0087 (.0749)	-
Other family income unknown	1.2035 (.9295)	.9343 (.6808)	1.6482 (1.2641)	1.3615 (1.0447)	1.0976 (.8440)	-

Table 2 (continued): OLS and IV Regression Results for 3- and 4-Year Olds: Dependent Variable is Standardized Score on Peabody Picture Vocabulary Test (t-ratios in parentheses)a

	(1) OLS	(2) IV	(3) OLS	(4) OLS	(5) OLS	(6) OLS
Personal Characteristics						
Black	-13.2315	-13.0711	-13.2775	-14.4458	-13.0904	-13.6353
	(-7.9738)	(-7.3917)	(-8.0229)	(-8.8246)	(-7.8769)	(-8.4038)
Hispanic	-9.1793	-8.9597	-9.3951	-9.6120	-9.2399	-9.7288
	(-4.8600)	(-4.4486)	(-4.9813)	(-5.0627)	(-4.8909)	(-5.1771)
Proportion of life spent in female-headed household	-.4829	-.3541	-.2946	-.1367	-.3647	-2.3144
	(-.2038)	(-.1406)	(-.1244)	(-.0573)	(-.1539)	(-1.5423)
Number of children	-2.0588	-.9721	-2.0964	-	-2.0494	-2.0076
	(-3.6345)	(-.4919)	(-3.7094)		(-3.6176)	(-3.5626)
Male	-2.2405	-1.8429	-2.3698	-2.2527	-3.0827	-2.1689
	(-2.2665)	(-1.5939)	(-2.3967)	(-2.2627)	(-2.0293)	(-2.1998)
Proportion of life mother's health would have limited work	-2.2948	-.5222	-2.2232	-2.9410	-2.4607	-2.3282
	(-.8671)	(-.1115)	(-.8421)	(-1.1058)	(-.9286)	(-.8787)
Child has health problem	-1.8400	-1.4197	-2.0497	-1.6733	-1.9404	-1.9134
	(-1.0157)	(-.6076)	(-1.1332)	(-.9174)	(-1.0703)	(-1.0635)
Proportion of life spent in South	-3.2056	-3.5293	-3.0706	-3.3352	-3.2146	-3.0890
	(-2.0695)	(-1.9812)	(-1.9866)	(-2.1384)	(-2.0756)	(-1.9993)
Proportion of life spent in West	1.1528	1.2132	1.0369	1.1372	1.1067	1.4195
	(.6430)	(.4910)	(.5797)	(.6298)	(.6166)	(.7951)
Proportion of life spent in North-Central	2.5739	2.8195	2.4675	2.1901	2.5120	2.6690
	(1.6110)	(1.6786)	(1.5481)	(1.3641)	(1.5717)	(1.6685)
Constant	90.1587	80.2023	90.4376	82.5912	90.7175	95.5044
	(16.7321)	(4.2866)	(16.7873)	(16.5002)	(16.6805)	(20.6513)
Adjusted R^2	.3629	.3283	.3664	.3537	.3631	.3593
Sample size	874	843	874	874	874	874

Appendix: Wage and Labor Supply Regressions

The tobit analyses used to construct fitted values for maternal labor supply are reported in Table A1. The samples used for estimating these equations excluded only children with serious disabilities and those with missing values for variables included in the labor supply analysis. All others for whom valid data were available were included. Hence, the sample sizes differ from one another, as well as from the 874 used in the child quality regressions. Region of residence, mother's health, mother's marital status, and the income variables correspond to the relevant interval for each regression. Thus, for example, spouse's average income is the spouse's income during the child's first year of life for the first regression, and the spouse's average income during the child's second year and subsequent years of life for the second regression.

The predicted wage is the fitted value from the wage regression estimated for labor force participants reported in Table A2.[26] Region of residence, years of education, and actual and potential work experience all refer to the calendar year prior to the birth of the child. Since the NLSY provides work history information only for the years of the survey (1979-86) and one year prior, we were unable to observe actual work experience for women prior to 1978. Thus we have included two experience variables in the wage regression. The first reports actual weeks worked between 1978 and one year prior to the birth of the child, and the second, an estimate of other potential experience, is equal to the number of years elapsed between the end of the mother's schooling and 1978.

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[26] As Heckman (1980) has shown, OLS regression coefficients estimated on the self-selected sample of labor force participants may be biased. However, since we found no evidence of selectivity bias (i.e., the coefficient on the inverse of the Mills ratio was not significant) OLS estimation was used in the results reported here.

Table A1: Coefficients of Two-limit Tobit Analyses Used to Construct Maternal Labor Supply Instruments[a] (asymptotic t-ratios in parentheses)

	(1) Proportion of Weeks Worked by Mother 1st Year of Child's Life	(2) Proportion of Weeks Worked by Mother 2nd and Later Years of Child's Life
Black	.0340	-.0360
	(1.365)	(-.889)
Hispanic	.0409	-.9414
	(1.334)	(-1.803)
South[b]	.0634	.0549
	(2.480)	(1.304)
West[b]	-.0865	-.1964
	(-2.872)	(-3.979)
North-Central[b]	-.0373	-.1263
	(-1.414)	(-2.907)
Health would have limited work[b]	-.0751	-.1683
	(-2.377)	(-2.515)
Married with spouse present[b]	.0430	.0886
	(1.499)	(1.718)
Unmarried with partner present[b]	.0346	.0170
	(.823)	(.223)
Child had low birthweight	-.0820	-.1512
	(-2.393)	(-2.573)
Predicted wage	.6304	.9714
	(11.373)	(10.474)
Spouse's average income (÷ $1000)	-.0059	-.0051
	(-5.802)	(-2.969)
Spouse's income unknown	-.0079	-.2751
	(-.134)	(-3.773)
Average other family income (÷ $1000)	-.0027	-.0111
	(-3.271)	(-3.302)
Other family income unknown	-.0347	.0331
	(-1.283)	(.862)
Constant	-.6363	-.8030
	(-6.819)	(-5.142)
σ	.3383	.4244
	(51.861)	(36.180)
ln(L)	-1146.0	-724.2
Sample size	1061	1034

[a] Predicted values are computed as Prob[non-limit] (β'X + $\sigma\lambda$), where Prob[non-limit] is the probability that the dependent variable lies in the interval [0, 1]. β is one of the vectors of coefficients shown above, X is the matrix of right-hand side variables listed above, and σ is the coefficient of λ, the hazard rate.

[b] This is defined as a dummy variable in column (1) and as the proportion of the intervals in column (2).

Table A2: Wage Regression Results for Mothers: Dependent Variable is the Log of the Wage Rate One Year Before the Child's Birth (t-ratios in parentheses)

Black	.0012
	(.022)
Hispanic	-.0344
	(-.478)
South	.0291
	(.539)
West	.1593
	(2.715)
North-central	.0596
	(1.115)
Verbal ability	.0871
	(3.545)
Verbal ability unknown	-.0247
	(-.320)
Years of education	.0541
	(4.236)
Actual weeks worked between 1978 and one year prior to birth of child	.0006
	(1.532)
Actual weeks worked unknown	.1000
	(1.331)
Potential years worked between end of schooling and 1978	.0206
	(1.319)
Constant	.8576
	(5.488)
Adjusted R^2	.1415
Sample size	536

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